Safety requirements for plastic sheet and film winders

HSE information sheet

Plastics Processing Sheet No 11 (Revision 1)

Introduction

This information sheet is one of a series produced by HSE's manufacturing sector and is aimed at all employers, supervisors and managers responsible for plastics and film processing finishing machinery. It has been significantly revised following recent incident investigations where people were injured during interventions on these machines. The main standards remain unchanged but it updates and clarifies requirements contained within the previous version. This guidance discusses the approach to risk assessment, safeguarding and systems of work. It sets benchmarks for safety and encourages users to reduce intervention tasks with the machines. It emphasises that it is not acceptable to rely on the voluntary action of a tripwire as the only means of safeguarding when there is a residual risk that cannot be adequately controlled.

Winders in the plastic and film industries are used to form flat sheet material into rolls. The sheet is made continuously and, as it approaches the winder, it often passes through a series of blades to trim the material to the desired width. The trimmed sheet is then formed into rolls of varying diameter, depending on how they will be subsequently processed. Similarly, rewind machines can be used to feed material from reel to reel for printing, slitting, inspection or similar processes. It is recognised that there are differing levels of guarding for winders in industry and that different interventions are required as a result of the product being manufactured. This information sheet gives advice on the commonly accepted and practicable safeguards for significant hazards on these machines.

Most commonly, winders are configured back-to-back where winding takes place, either on one or both sides at the same time.

Rewinders are individual sided machines that can either unwind the roll for processing, or return it into a roll after processing.

Safeguarding for existing machines is covered by the Provision and Use of Work Equipment Regulations 1998 (PUWER) – further guidance in *Safe use of work equipment*.[1] New machines manufactured after 2004 should be constructed to the harmonised standard BS EN 13418:2013.[2] However, you should still use this guidance to review safeguarding measures for machines built after the standard came into effect, as well as those built before it came into effect, to make sure that they are meeting the minimum levels of protection required.

The four key areas relevant to all winding machines are:

- identifying hazards and issues;
- types of winding machine;
- identifying and controlling intervention tasks;
- physical protection against dangerous parts.

Identifying hazards and issues

Figure 1 Drive roll arrangement

Winding normally takes place onto a cardboard core. The core is inserted onto a steel shaft known as a reel bar that is inflated via air pressure and this secures the core in place. The reel bar is non-powered but when placed with the cardboard cores at a tangent against the winder drive drum it rotates and winds the sheet (Figure 1). A nip hazard is created at this point across the full width of the machine.

The reel bar is supported against the winding drum and restrained by guide arms. These are hydraulically-, pneumatically- or electrically-powered, slow-moving,

automated transfer arms that are normally hold-to-run control and withdraw the finished reel away from the contact point with the winder drive roll. A new blank reel bar is then inserted to start production of the next reel. The winding drum travels faster than the rest of the process line to tension the sheet (ie any slack in the system is picked up).

Contact with any rollers moving at speed can be hazardous, but falling onto or having contact with profiled or rubber-covered rolls can result in the operator being drawn into the machine. The risk increases with smaller diameter rolls and/or with loose clothing.

Winders include the following hazards:

- nip/drawing in against the drive drum (typical processes can run up to 150 m per minute);
- in-running nip between rotating rollers;
- running nip between rotating roller and product;
- contact with trim knives located at the sides of the working width of the machine (sharp blades that remove the edges of the sheet);
- contact with vertical slitter knives located at various intervals across the working width of the machine;
- contact with the cross-cutter knife (or flying knife). This is a powered blade that traverses the width of the machine to cut the sheet when the desired reel diameter has been achieved. There is additional risk of amputation or cut injury from machines fitted with automatic cross-cutter devices. These can start up unexpectedly due to their automated nature;
- crushing points between fixed machine parts and reel loading/unloading arms.

Opening interlocked guards and activating safety trips (including e-stops) should stop the winder (both sides for back-to-back winders). These devices tend to stop the winder only, allowing the remainder of the process line to continue producing material; however, a build-up of waste product is then created elsewhere.

As the fresh reel is building, the winder drive drum is exposed. The building reel acts as a safeguard to keep people away from the majority of the dangerous parts in this area, although if the reel is not the full width of the machine there could be access to dangerous parts from the front sides (this distance would vary depending on the overall width of the finished reel/split reels).

Previously, trip wires were used as the primary safeguard during machinery intervention. The principle was that the trip wire would be actuated by an involuntary action if a person were to be drawn into the machine. However, it is unlikely that the trip wires would activate in this way and would need a voluntary action to activate them, which may not be possible if the operator is drawn into the machine or the trip is beyond their reach. Inspection experience has also found that interlocked safeguards on winding machines such as pressure mats and electro-sensitive protective equipment (ESPE) have been switched off for long periods during machine operation to carry out interventions in close proximity to the machine.

Standards allow that where there are non-powered or low-powered rollers on winding machines spaced sufficiently not to create nip points, or if the rolls can be stopped by one hand, then no further safeguards are required. However, you should consider the risk of entanglement on winding machines, eg from long hair or loose clothing. Additional safeguarding may be needed if there is a risk present.

On back-to-back winders, various common components (eg trim/offcut extractor pipework) are used by each side of the winder in order to roll the sheet up. This can also include the integration of safety controls, as on many winders the drive mechanisms are common to both sides – what happens to one, happens to the other if it is active. Therefore, any sequenced movement of machine parts following a trip (such as backing off and raising reel arms) may have an unexpected movement to anyone located at the other side of the machine.

Action

Review the adequacy of your safety controls to existing winding machines:

- Assess the current level of guarding on all winding machines and, where there are unguarded areas, provide guarding.
- Assess the specific intervention tasks needed for each winder and identify controls. Your starting point should be: can these be done remotely? This may involve installing access platforms or modifying the machine to be able to make adjustments remotely. Where it is not possible to intervene remotely after modifications then you will need to identify a package of controls to protect workers. (See ‘Types of winding machines’ for more information and guidance.)

Types of winding machines

There are four different types of winders:

- ***Fully automatic winders*** – usually on continuous production lines (eg blown film) and are intended to operate non-stop so the need for manual intervention is limited to initial start-up, job changes or troubleshooting.

- ***Semi-automatic winders*** – usually on continuous production lines and include various functions initiated by manual control (such as the flying knife and/or reel change). These winders have the same hazards as fully automatic machines and are the most commonly used type in industry.
- ***Manual winding machines*** – the simplest type of winder, typically found on slow-running production lines. They often include only basic functions (eg there may be no reel-loading arms, or cross-cutter knife).
- ***Rewinders*** – used to unwind the reel for additional process work, such as printing, slitting, inspection or other activity (sometimes referred to as conversion process). They may also be used to return the flat sheet to a reel once conversion is completed. They are not therefore used in a continuous production line, and don't have the same time pressures to return to production.

All types of machine will have some (if not all) of the hazards described in this information sheet. However, the type of winding machine will affect how the risks are controlled. You should use this document to review the type of winder(s) you have, the activities you undertake and review the controls in place to ensure you are adequately controlling the risks.

Identifying and controlling intervention tasks

Identifying intervention tasks

All winding machines will have varying degrees of manual intervention during the normal production process. The following are common activities that are more likely to be carried out in close proximity to the front face of the machine on semi-automatic winders during machine operation. The activities described are based on common known practices. You should use the list as a basis to record and challenge whether it is necessary to carry out these tasks in this way and identify how safety for these (and any other) tasks can be improved regardless of machine type:

- **Feeding up the sheet:** This is the process of threading the plastic film or laminate through the machine. Ideally, the existing sheet should be left in the winder and new sheet attached. Where this is not possible, eg if the sheet is lost, then ropes or manual threading can be used to draw the sheet through the idle rollers. The winder should be stopped during threading and then slow speed (ie <20 m per minute) should be used before increasing the winder to normal running speed. Reversed adhesive tape (or similar) should be applied to the scrap core (or reel) so that when the start-up film is cut it is taken onto the core (scrap reel) without further intervention.
- **Dressing and removal of the finished reel:** Once the reel reaches the required diameter, the cross-cutter knife slices across the sheet and the reel is moved away from the drive drum either by the unloading arms or by releasing a catch that allows the reel to transfer to the unloading arms. The operator then stands in front of the reel to tape up the loose end of the sheet from the finished reel. Unloading arms are then operated sometimes by hold-to-run control to further lower the reel onto a movable table or pallet.
- **Installing a new reel bar/cores:** Some winders are fitted with an automatic loading system that allows loading of reel bars/cores remote from the front face of the winder. Machines without an automatic loader often include an overhead hoist with travel rails to allow remote loading of blank reel bars/cores. In some circumstances (even with automated equipment) there is established practice for two operators to manually load the reel bars/cores by standing in close proximity to the building reel.
- **Sampling/making a join:** Once production is underway there may be a quality control need to take a sample. A similar process can also be carried out if a join is made in the sheet. The operator stands in front of the reel and uses a knife to slit across the full front face of the sheet. As material continues to discharge a second cut is made, providing a sample piece. The discharging sheet will then be manually located back on the finished reel. A marker (paper insert) is applied to identify the position of the join as the reel continues to wind.
- **Trim wrap-up:** The trimmed edges from the sheet are removed via an extraction system. The extraction system can block as the operating speed increases causing trimmed material to become entangled in the finished reel. This requires manual intervention to pull material out of the way. This can be a pressured task as speedy intervention is needed to prevent the trim being drawn into the saleable sheet and to prevent machine shutdown.
- **Sheet break:** During production, it is possible for the sheet to accidentally break. This may also be done deliberately if a problem occurs downstream in the process. This requires manual intervention to pull material out of the way and remove any residue. This can be a pressured task while the film/laminate continues to be produced and begins to build up.
- **Job change:** When a reel reaches the required diameter the sheet is slit. This can be done by an automated (or remotely initiated) cross-cutter knife. If such a knife is not installed then this task will require manual intervention with the operator standing next to the subsequent building reel using a sharp knife to cut across the sheet.

Controlling intervention tasks

Making changes to existing practices can often eliminate the need to enter the front face of the winder while the machine is at normal operating speed. Where intervention tasks are identified that cannot be done with the machine at a standstill, the operator should carry them out with the machine running at a significantly reduced operating speed and machine functionality limited, where practicable. Intervention tasks should not be carried out with the machine operating at normal operating speed without adequate safeguards in place.

When you review intervention tasks, firstly consider if the task can be done remotely. You should take measures to eliminate/reduce access to the front face of the machine and consider foreseeable intervention tasks (most of which are identified above). This can include:

- preparing the fresh reel bar/cores away from the machine using predetermined datum used to set the slitter knife positions;
- operating loading/transferring arms to withdraw finished reel from powered winding drum, before dressing finished reel;
- building up, aligning and taping reel cores ready for installation remotely;
- installing/retrofitting automatic loading systems to eliminate the need for manual intervention to load fresh cores;
- where it is not practicable to install automatic loading systems, using or fitting an overhead hoist to be used under a safe system of work to load fresh reel bar/cores;
- agreeing and monitoring a safe system of work for reel start-up while machine is stationary.

Remaining interventions should, wherever possible, be done with the machine stationary, or at a significantly reduced speed and function. This will reduce the level of risks during front access.

Where it is not possible to reduce functionality, for example by using a hold-to-run control device to move or lower pneumatic or hydraulic arms, then other safeguards should be in place, eg providing fixed guarding around the moving arms.

It is not acceptable to carry out intervention tasks with the machine running at normal speed without additional safeguards in place to protect operators.

If the machine has an accumulator then intervention should be done with the winding parts stationary. Retrofitting accumulators is not practicable due to space limitations.

Use of zoning

Carry out machine interventions either with the machine stationary or with all safeguards in place and functioning. If this is not practicable, and they can only be done with the machine in motion with parts of the safeguarding system inoperative, then additional controls are needed. The additional controls should reduce the functionality and speed of the machine. Winders used in this way should be changed to incorporate some form of safety zoning that will involve changes in how the machine operates.

On manual machines it may not be possible to introduce zoning as described below. Assess the risks involved on your machine and identify the correct control measures to reduce the risks.

Examples of safety zoning are:

Zone 1: Provides general safeguarding during normal operation to ensure reach distances are maintained and access to dangerous parts prevented. This would typically be via ESPE or pressure-sensitive mats.

Zone 2: Ensures the slowest speed practicable and disabling of all functions with the exception of the winder drive drum. The changeover mechanism should also incorporate *either:*

- activation of a local involuntary trip device(s) near the drive drum, specifically positioned for this purpose. This may be via retrofit of a single-beam ESPE, or two single beams placed in the top quarter of the drive drum. It is recommended that zone 2 devices are not left active permanently, as they may increase the risk of nuisance trips; *or*
- a hold-to-run device incorporating slow speed or limited movement of the drive drum.

When initiating zone 2, a mode selector switch should be provided to override normal operation and initiate the reduced functionality and additional safety controls. The mode selector control should be *either* fixed and located outside of the danger point/area *or* portable so it can be taken by the operator into the danger point/area. In both instances this disables the perimeter protection from the front (zone 1) and activates local protection (zone 2).

Physical protection against dangerous parts

Figure 2 Example of side guarding

All machines should be fully guarded at the sides to prevent an operator reaching in and accessing dangerous parts (see Figure 3) as there is no need for access from these positions.

Provide other safeguards to the front face of the machine. Any additional rollers that can be accessed from the front face of the winding drum should be either relocated, or the gap reduced, so as to minimise risk of entrapment/crush injury.

Determine a package of measures to protect the front face of the winding machine.

Figure 3 Example of ESPE zone 1 protection

Figure 4 Example of pressure mat zone 1 protection

Some machines include ESPE to the front face (see Figure 3), while others include pressure mats (see Figure 4). Other safety devices are also available, such as laser scanners and other sensitive protective devices that can help improve safeguarding standards.

While tripwires can minimise accidents and injuries, they do not always prevent them and the law requires a more effective form of safeguarding where this is practicable. Tripwires should therefore not be considered as a primary safeguard.

By applying the principles set out in this guidance note, improvement in safeguarding and a reduction in interventions will reduce the additional time required to restart and stabilise the process.

References and further reading

References

1 *Safe use of work equipment. Provision and Use of Work Equipment Regulations 1998. Approved Code of Practice and guidance* L22 (Fourth edition) HSE Books 2014 www.hse.gov.uk/pubns/books/l22.htm

2 BS EN 13418 *Plastics and rubber machines. Winding machines for film or sheet. Safety requirements* British Standards Institution

Further reading

Buying new machinery: A short guide to the law and your responsibilities when buying new machinery for use at work Leaflet INDG271(rev1) HSE Books 2011 www.hse.gov.uk/pubns/indg271.htm

For health and safety in plastics manufacturing premises see HSE's plastics webpages www.hse.gov.uk/plastics/

For PUWER and CE marking see HSE's work equipment/machinery webpages www.hse.gov.uk/work-equipment-machinery/

Further information

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